I. I. P.

Creating Future Fuels

TENDER DOCUMENT

Refer Advt.No./Tender Notice No.02/2006-07

P.O. I.I.P MOHKAMPUR, HARIDWAR ROAD
DEHRADUN- 248005, UTTARANCHAL, INDIA
Ph.2660113-116, 2660072 (D), Fax: (0135) 2660202/2660203
E-mail Purchase@iip.res.in
Website: www.iip.res.in

GLOBAL TENDER NOTICE NO. 02/2006-07

Sealed tenders under two bid system (Part 1 Technical bid along-with EMD and Part II Price bid) are invited from the Indian/Foreign manufactures/Authorized Distributors OR Indian Agents for the supply, installation and commissioning of goods as per details given below:

S. No	Tender No. & Specifications	Qty.	Cost of Tender (Rs.)	EMD (Rs.)
1.	No.:PUR/1/06-07/AFLD/119/ Emission Facility for Mass Emission Measurements from Heavy Duty Engines using Transient Engine Dynamometer as per Bharat Stage III/IV, US Stop and European Norms as per Specifications enclosed.	One	*	35 Lacs
* Nil in case Tender Document is Downloaded from our website, other wise Rs. 300.00 if it is obtained from IIP.				

Tender document having detailed specifications, terms and conditions can be downloaded only from our website **www.iip.res.in** from **06/07/2006** and be submitted superscribing on the envelope the Tender No. & Due Date in the Office of Controller of Administration, IIP, Dehradun latest by **17/08/2006** upto **11:00 a.m.** along with the **EMD as mentioned above** separately by way of **demand draft/bankers cheque/Bank Guarantee only** in favour of the **Director, Indian Institute of Petroleum, Dehradun**. If the EMD is not deposited such tenders will be rejected. The tender fee is non-refundable. The tenders will be opened on **17/08/2006 (Tuesday**) at **11:30 a.m**. This office will not be responsible for delay, loss or non-receipt of NIT after dispatch. Late tenders received after the scheduled date and time will not be opened/considered in any case.

Director, IIP reserves the right to accept or reject any or all tenders either in part of in full without assigning any reasons thereof.

Stores & Purchase Officer

CONTENTS

Tender Document

Tender No.

Item Name: (To be filled by the firm)

Last Date & Time for submission of tenders alongwith EMD in IIP : till 11.00 a.m. of 17th August, 2006

Date & Time of Opening of Tenders at IIP : at 11.30 a.m. of 17th August, 2006

Late, delayed, incomplete Tenders and amendments and additions to tender after opening will not be accepted.

The bidders and their authorized representatives are at liberty to be present at the time of opening of the Tenders.

Cost of Tender Documents : Rs.300.00

(Tender Fees nil in case Tender Document is Downloaded from our website, other wise Rs. 300.00 if it is obtained from IIP.)

Indian Institute of Petroleum

P.O.I.I.P., Mohkampur, Haridwar Road,

Dehradun – 248 005

Fax: 0135-2660202/2660203, Ph. 2660113-116/2660072

E-mail:purchase@iip.res.in

Website: www.iip.res.in

Sold to:

M/s _____

_____

_____

_____

INSTRUCTIONS, TERMS AND CONDITIONS FOR SUPPLY OF MATERIAL/EQUIPMENT ETC.

Gentleman,

For and on behalf of the Council of Scientific & Industrial Research, The Director, IIP, Dehradun invites quotations for supply, installation and commissioning of the equipment detailed in Annexure-A.

The successful tenderer will be required to enter into a contract with the Council/IIP/ regarding purchase/supply.

The contract that may eventuate from the tender will be governed by the conditions detailed herein, if you are in a position to quote for supply, installation and commissioning of the equipment/system as per the schedule A attached hereto. You may please submit the quotations in duplicate on the said Tender form as per annexure 'A' & 'C' and instructions contained herein. All offers and documentation should be made in **English** language only.

Tenderers shall furnish details of the back-up engineering and system support that will be made available of the Council/IIP as per format at annexure 'F'.

Tenderers shall enumerate the operational experience in similar equipment offered for a period of last five years alongwith names addresses and order references of users installations, their telephone numbers, Fax nos.and E-mail addresses as per format at annexure 'E'.

The Council/ Director, IIP reserves the right to revise or alter the specifications of the equipment before the acceptance of Tender or reject any tender or part thereof or whole of the Tenders without assigning any reason.

Each copy of the Tender should be a complete document and should preferably be bound as a Volume.

Conditional tenders shall not be accepted.

DETAILED CONFIGURATION, SPECIFICATION OF THE EQUIPMENT OFFERED

Tenderers should enclose with their offers full details of the latest technology available with full documentation, descriptive literature/ leaflets supplementing the description, and point out any special features of their system only. This information should be submitted separately as per annexure 'A'.

Tenderers must state categorically whether or not their offer is exact to tender specifications and indicate deviation if any, in the format at annexure 'D' failing which their offer will be ignored.

QUALIFICATION CRITERIA:-

i. The bidder should be a manufacturer/authorised representative of a manufacturer who must have designed, manufactured, tested and supplied the equipment (s) similar to the type specified in the "Schedule A". Such equipments must be of the most recent series/models incorporating the latest improvements in design. The models should be in successful operation for at least one year as on date of bid Opening.

ii. The bidder should furnish the information on all past supplies and satisfactory performance in the proforma given, at annexure 'E'.

iii. Bidders shall invariably furnish documentary evidence (client's certificate) in support of the satisfactory operation of the equipment.

iv. Details of Service Centres and information on service support facilities that would be provided after the warranty period (In the Service Support Form given in annexure 'F').

v. Information regarding any current Litigation in which the Bidder is involved.

vi. That the Bidder will assume total responsibility for the fault-free operation of equipment, application software (if any) and maintenance during the warranty period.

vii. Bidders who meet the criteria given above are subject to be disqualified, if they have made untrue or false representation in the forms, statements and attachments submitted in proof of the qualification requirements or have a record of poor performance, not properly completing the contract, inordinate delays in completion or financial failure, etc.

viii. Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected. If the supplier does not accept the correction of errors, its bid will be rejected. If there is any discrepancy between the price quoted in figures and words, whichever is the higher of the two shall be taken as the bid price.

ix. To facilitate evaluation and comparison, the purchaser will convert all bid prices expressed in the amounts in various currencies in which the bid prices are payable to Indian Rupees at the selling exchange rate established by any bank in India as notified in the newspapers on the date of bid opening.

PROTECTION AGAINST DAMAGE

Fail safe procedure in detail under following conditions may be indicated in detail:

(a) Power failure (b) Voltage variations

The equipment must be capable of withstanding power failures and equipment should not be prone to damage due to power failures and trip outs. The normal voltage and frequency condition available at the site are as follows:

Normal Voltage : 400V ± 10% 3 phase 4 wire system unless stated otherwise.
: 220V ± 10% Single Phase

Frequency : 50 ± 5% Hz

SPARE PARTS

Tenderers should include in their tender, provisions for tools and initial stock of maintenance spares as are essential for proper operation and maintenance of the equipment. Full particulars of spare parts should be provided separately.

In addition to above, estimated requirements of spares consumption per annum should be indicated.

The successful tenderer shall guarantee that spare parts for the system would be available for a minimum period of Ten (10) years after acceptance of the system/equipment. And thereafter before going out of production of the spare parts, he will give a notice prior to such discontinuation and intimate alternate source of supply for spare parts.

INSTALLATION, ERECTION, COMMISSIONING & ACCEPTANCE AT SITE

The tenderers shall be responsible for erection & installation of the equipment at destination site and for making it fully operational, without any additional cost/free of charge. The installation, erection and commissioning must be completed within one month after receipt of consignment at IIP Dehradun.

The tenderers must provide complete details regarding space and all infrastructure requirements needed for the equipment which IIP should arrange before the arrival of equipment in IIP to ensure its early installation and smooth operation thereafter. (The successful bidder may offer his advice and render assistance to IIP in the preparation of the site and other pre installation/commissioning requirements). The supplier shall inform IIP about the site preparation, if any, needed for installation, immediately after receipt of the Purchase Order.

MANUALS & DRAWINGS

Before the goods and equipment are taken over by IIP, the supplier shall supply operation and maintenance Manuals together with Drawings of the goods and equipment and circuit diagrams in duplicate. These shall be in such details as will enable IIP to operate, maintain, adjust and repair all parts of the works as stated in the specifications.

The Manuals and drawings shall be in English language only. Unless and otherwise agreed, the goods and equipment shall not be considered to be

completed for the purpose of taking over until such manuals and drawings have been supplied to IIP.

WARRANTY

The tenderer shall be fully responsible for the manufacturers warranty in respect of proper design and workmanship of all the equipment accessories etc. covered by the tender for a period of 12 months from the date of installation and acceptance of the equipment . If the equipment or part thereof becomes un-operational during the warranty period the same part or whole equipment will have to replaced at IIP free of cost on CIF basis and the equipment will have to be put under operation within a reasonable period of time. Any down time of the equipment during the warranty period shall proportionately extend the Warranty period further till such time the rectifications/repairs have been undertaken. The warranty certificate as per annexure 'B' should be signed, dated and stamped and enclosed alongwith each copy of the bid.

TRAINING

Tenderers shall make provision for imparting training to our Scientists/maintenance engineers on operation and use of equipment, its accessories and software for the intended applications and trouble shooting, repair and maintenance without any additional cost including to and fro passage, boarding & lodging and local hospitality, wherever applicable.

PERFORMANCE STATEMENT

If the vendor / bidder has supplied identical or similar equipment to other CSIR labs/Institute. The details of such supplier for the preceding 5 years shall be given together with the prices eventually or finally paid. The information shall be submitted as per the format enclosed at annexure 'E'.

SUB-CONTRACTS:

The supplier shall notify the purchases in writing of all sub-contracts awarded under this contract if not already specified in the bid. Such notification, in his original bid or lates, shall not relieve the supplier from any liability or obligation under the contract.

Sub-contract shall only for bought out items and sub-assemblies .

EARNEST MONEY DEPOSIT

i. The bidder shall furnish, as part of its bid , a bid security for the amount specified in the NIT, as per annexure 'G'.
ii. The bid security is required to protect IIP against the risk of Bidder's conduct which would warrant the security's forfeiture.
iii. The bid security shall be denominated in the currency of the bid or in Indian Rupees, and shall be in one of the following forms:

    a. A bank guarantee issued by a reputable bank located in India or abroad, in the form provided in the bidding documents valid for thirty (30) days beyond the validity of the bid or

b. Demand draft or Bankers cheque..

iv. **The bid security needs to be included with the technical bid only.**

v. **Any bid not secured in accordance with above provisions will be summarily rejected by IIP as non-responsive,**

vi. Unsuccessful bidders bid security will be discharged or returned as promptly as possible but not later than fifteen (15) days from the award of contract to the successful bidder.

vii. The successful bidder's bid security will be discharged upon the successful bidder submitting the order acceptance and furnishing Performance Bank Guarantee.

viii. The bid security may be forfeited:

(a). If a Bidder withdraws its bid during the period of bid validity,

(b) In the case of successful Bidder, if the Bidder fails:

i. To submit the order acceptance within 21 days from the date of placement of Purchase Order.

ii. To furnish performance B.G. within 30 days from the date of placement of Purchase Order.

ix. Firms registered with DGS&D, NSIC who are exempted from payment of EMD (Certificate is required to be enclosed) are exempted from payment of EMD, provided such registration include the item they are offering are manufactured by them.

TECHNOLOGY CERTIFICATE

The supplier should issue a certificate stating that:

a) The equipment is of latest technology

b) The equipment may be upgraded as and when required by IIP, and

c) The equipment will be promptly and properly serviced by them whenever desired by IIP.

PRICES

Prices should be shown separately for each item (foreign exchange component/rupee element separately) viz. basic unit, its accessories, computer, software, critical spares/components etc. Offers not indicating item wise prices are liable to be rejected. The details of the prices offered should be submitted as per the format at annexure 'C' and enclosed only with the Priced Bid.

The offer should be valid for a period of 180 days from the date of opening of Techno Commercial bid. Conditional tenders shall not be accepted.

FOR GOODS OFFERED FROM WITHIN INDIA

The prices quoted must be firm and on EXW basis. The excise duty and Sales Tax payable must be indicated separately. The cost of forwarding, inland transportation, packing, insurance and local costs incidental to delivery of the goods to IIP, Dehradun must also be explicitly indicated in the Tender alongwith discount, if any. While quoting rate per unit specified in the schedule, tenderers are required to give total cost as well. Further, IIP is exempted from payment of EXCISE DUTY and authorize to issue "Form of Certificate" for sales tax concessions.

WHERE THERE IS NO MENTION OF PACKING, FORWARDING, INLAND TRANSPORTATION, PACKING, INSURANCE etc., SUCH OFFERS WOULD BE SUMMARILIY REJECTED AS BEING INCOMPLETE.

FOR GOODS OFFERED FROM ABROAD

The prices quoted must be firm and on F.O.B./F.C.A. Port of shipment basis. Different components of prices for insurance, freight, and discount, if any, should be shown separately. While quoting rate per unit specified in the schedule, tenderers are required to give total cost as well. IIP is exempted from payment of Custom Duty in terms of GOI Notification No.51/96-Customs Dt.July 23,1996 and Central Excise Duty exemption in terms of Government Notification No.10/97-Central Excise Dated 1st March,1997.

TERMS OF PAYMENT AND PERFORMANCE BANK GUARANTEE

Payment shall be made by IIP through an irrevocable letter of credit to the extent of 80% on production of shipping documents and the balance 20% will be paid after completion of installation, commissioning and acceptance of the system/equipment to the entire satisfaction of council/IIP and on production of unconditional performance bank guarantee for 20% FOB value valid till 60 days after the date of completion of the supplier's performance obligations, including any warranty obligations from the date of acceptance of the goods/equipment. The performance bank guarantee should be issued by a scheduled bank. Other payment terms acceptable to the tenderers must be mentioned explicitly in the deviation statement form as per annexure 'D'.

FAILURE OF THE SUCCESSFUL TENDERER TO COMPLY WITH THE ABOVE REQUIREMENT SHALL CONSTITUTE SUFFICIENT GROUNDS FOR CANCELLATION OF THE PURCHASE ORDER.

The proceeds of the performance security shall be payable to IIP as compensation for any loss resulting from the supplier's failure to complete its obligations under the contract.

THE PERFORMANCE BANK GUARANTEE WILL BE DISCHARGED BY IIP AND RETURNED TO THE SUPPLIER NOT LATER THAN SIXTY DAYS FOLLOWING THE DATE OF COMPLETION OF THE SUPPLIER'S PERFORMANCE OBLIGATIONS, INCLUDING ANY WARRANTY OBLIGATIONS.

The unconditional performance bank guarantee of 20% is to be given by the manufacturer or his agent prior to opening of L/C in case of 100% payment and that bank guarantee should remain valid for 60 days beyond the warranty period from the date of acceptance of the goods/equipment. In this case performance bank guarantee should reach IIP within 30 days of the placement of Purchase Order.

All bank charges within India will be borne by IIP and all bank charges outside India will be borne by the supplier LC would be opened only after receipt of order acceptance. The order acceptance should be given within 21 days from the receipt of purchase order. If the LC is required to be amended later on against written request then the bank charges would be to the account of the beneficiary.

DELAYS IN SUPPLIER'S PERFORMANCE

Delivery of the goods, equipment and performance of services shall be made by the supplier in accordance with the time schedule agreed upon and indicated in the Purchase order.

If at any time during performance of the Contract, the supplier encounters conditions impeding timely delivery of the goods and performance of services, the supplier shall promptly notify IIP in writing of the fact of the delay, its likely duration and its causes. As soon as practicable after receipt of the Supplier's notice, IIP shall evaluate the situation and may at its discretion extend the supplier's time for performance, with or without Liquidated damages.

Except as provided in Force majeure clause, a delay by the supplier in the performance of its delivery and performance of services, obligations shall render the supplier liable to the imposition of the liquidated damages, unless an extension of time is agreed upon without the application of liquidated damages.

LIQUIDATED DAMAGES

Subject to Force majeure clause, if the supplier fails to deliver any or all of the goods or to perform the services within the period(s) specified in the Contract, IIP shall, without prejudice to its other remedies under the Contract, deduct from the Contract price, as liquidated damages, a sum equivalent to 0.5% of the contract price for each week or part thereof of delay until actual delivery or performance of services upto a maximum deduction 10%. Once the maximum is reached, IIP may consider termination of the Contract.

FORCE MAJEURE

Notwithstanding the provisions of Clauses related to delay in supplier's performance and liquidated damages, the Supplier shall not be liable for forfeiture of its performance bank guarantee, liquidated damages if and to the extent that its delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

For purposes of this clause, "Force Majeure" means an event beyond the control of the Supplier and not involving the Supplier's fault or negligence and not foreseeable. Such events may include, but are not restricted to, acts of the IIP in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions, land freight embargoes.

If a Force Majeure situation arises, the Supplier shall promptly notify IIP in writing of such condition and the cause thereof. Unless otherwise directed by IIP in writing, the supplier shall continue to perform its obligations under the contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.

RIGHT TO USE DEFECTIVE GOODS

If after delivery, acceptance and installation and within the guarantee and warranty period, the operation or use of the goods/equipment proves to be unsatisfactory, IIP shall have the right to continue to operate or use such goods/equipment until rectification of defects, error or omissions by repair or by partial or complete replacement is made without interfering with IIP's operation.

TERMS AND CONDITIONS OF TENDERING FIRMS

Printed terms and conditions of the tenderers will not be considered as forming part of their tenders. In case terms and conditions of the contract applicable to this invitation to tender are not acceptable to any tenderer, that should be clearly specified as deviation in the deviation statement form as per annexure 'D'. The Council/Director IIP reserves the right to accept or reject them. The Council/Director IIP shall not be bound to give reasons for his refusal to consider the tender with such deviations.

SIGNING OF TENDER

Individual signing the tender or other documents in connection with the contract must specify whether he signs as:-

i) a "Sole proprietor" of the firm or constituted attorney of such sole proprietor;

ii) constituted attorney of the firm it is a company.

Note: A person signing the Tender Form or any documents part of the contract on behalf of another shall be deemed warranty that he has the authority to bind other and if, on enquiry it appears that the person so signing has no authority to do so, the purchaser may, without prejudice to other civil and criminal remedies, cancel the contract and hold the signatory liable for all cost and damages.

INSTRUCTION FOR INDIAN AGENTS

Agents in India of Foreign Manufacturers shall submit along with the tender an Income Tax Clearance Certificate authorization from the manufacturer

along with other relevant document in support of their being agents of the foreign manufactures. The agency commission (expressed as percentage of FOB/EXW cost) payable to the Indian agent, included in the offer, should be clearly indicated. In case the items fall under the restricted category of the current EXIM Policy of the Govt. of India, Indian Agents of foreign supplier should be registered with DGS&D and a copy of Registration Certificate should be furnished with the Technical Bid.

ARBITRATION CLAUSE:

The IIP and the Supplier shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the Purchase.

If, after thirty (30) days from the commencement of such informal negotiations, IIP and the Supplier have been unable to resolve amicably a Contract dispute, either party may require that the dispute be referred for resolution to the formal mechanisms as under.

In the case of a dispute or difference arising between IIP and the Supplier relating to any matter arising out of or connected with the agreement, such dispute or difference shall be referred to the award of two Arbitrators, one Arbitrator to be nominated by IIP and the other to be nominated by the Supplier or in the case of the said Arbitrators not agreeing, then to the award of an Umpire to be appointed by the Arbitrators in writing before proceeding with the reference, and in case the Arbitrators cannot agree to the Umpire, he may be nominated by the Director General, Council of Scientific And Industrial Research, New Delhi. The award of the Arbitrators, and in the event of their not agreeing, of the Umpire appointed shall be final and binding on the parties.

The Indian Arbitration & Conciliation Act 1996, the rules there under and any statutory modification or re-enactments thereof, shall apply to the arbitration proceedings.

The venue of arbitration shall be IIP, Dehradun.

SUBMISSION OF TENDER

Bids duly sealed are to be submitted in two parts separately (Technical and price Bid). The tender in a sealed cover superscribing Tender No., Serial no. and name of the Equipment tendered may be sent to:-

The Director,
Indian Institute of Petroleum
P.O. Mohkampur,
Dehradun

FAX : 0135-2660202/2660203
GRAM : PETRINST
PHONE ; 0135-2660113-16
EXTN 254/262 OR 2660072
Email: purchase@iip.res.in

The Tenderer can also submit the bid in person at the office of controller of Administration, IIP, Dehradun.

The Inner envelopes containing the techno commercial and priced bid should also indicate the Tender No., Serial no. and name of the Equipment tendered.

Tenderers who are accredited with ISO 9000/9001/9002/9003 certificate will get the preference.

All offers should be made in Two parts viz. Technical and Price Bids separately, in English. The technical bid should contain the EMD/Bid Security.

NOTE :

1. Tenderers should sign, date & stamp the tender documents in token of their acceptance of the terms & conditions and return in original along with the tender. Terms & conditions contained in the tender documents which are not acceptable should be deleted and signed and the deviations should be indicated in the deviation statement form as per annexure 'D'.

2. The tenderer is expected to examine all instructions, forms, terms and specifications in the bidding documents. Failure to furnish all information required by the bidding documents or to submit a bid not substantially responsive to the bidding documents in every respect will be at the tenderer's risk and may result in rejection of the bid.

VALIDITY OF OFFERS

The tender shall remain open for acceptance until 180 days from the date of opening of techno-commercial bid.

If the day upto which the offer is to remain open has been or is declared to be a closed holiday, the offer shall remain open for acceptance till the next

working day. The tenders qualified by such vague and indefinite expressions such as 'Subject to prior sale" will not be considered.

CLIENTAL LIST

List of Clients to whom the instrument/equipment already supplied in India alongwith reference from clients regarding its performance as per **Annexure-E.**

RIGHT OF ACCEPTANCE

The Council/DIIP does not bind itself/himself to accept the lowest or any tender and reserves the right of accepting the whole or any part of the tender or a portion of the quantity offered and the tenderers shall supply the same at the rate quoted.

FREE SERVICE

Tenderers are required to give full particulars of free service that they would give to IIP, Dehradun during the period of Warranty and subsequently.

Yours faithfully,

Stores & Purchase Officer

Please also give the answer of this question (✔) tick against your answer

Q. How you came to know about the Tender whether through New Papers Or both.

Ans. Newspapers Or Website Or Both

INDIAN INSTITUTE OF PETROLEUM, DEHRADUN

TECHNICAL SPECIFICATIONS OF THE FACILITY FOR MASS EMISSION MEASUREMENTS FROM HEAVY-DUTY ENGINES USING TRANSIENT ENGINE DYNAMOMETER AS PER BHARAT STAGE-III/IV, U.S. AND EUROPEAN EMISSION NORMS

CONTENTS

1.0 PREAMBLE

This facility is required for mass emission measurement from heavy-duty engines using transient engine dynamometer as per Bharat stage III/IV, US heavy-duty 2007 and European emission norms. The facility shall be in accordance with the European Directive 2005/78/EC amended from 2005/55/EC for the measurement of emissions of gaseous and particulate pollutants from diesel engines from EURO III & IV emission norms and should also meet the requirements of US heavy-duty 2007 test procedure. All the components, hardware and software shall be included in the offer to comply as per European Directive 2005/78/EC and 2005/55/EC for heavy-duty engines operating on diesel, gasoline, CNG, LPG and alcohol fuels. The facility should be capable of following Indian, U.S. and European, legal cycles, legal certification calculations and regression analysis, etc. as required by the regulations for heavy-duty engines mass emission measurements. The system should be upgradeable to Euro-V requirements, whenever required.

The facility should be designed keeping in view the Indian electrical supply conditions. The voltage supply available is 220 V, single phase and 400 V, 3 phase with 50 Hz frequency. The system should be able to tolerate 10 % fluctuation in the voltage. IIP would be providing water at ambient temperatures and if chilled water is required for engine coolant, oil conditioning, fuel conditioning, engine intake air conditioning, particulate system etc., chillers required should be a part of the offer.

The facility should be complete in all respects as detailed in the subsequent sections.

2.0 SCOPE OF SUPPLY

The supplier will be completely responsible for the system layout and its supervision during installation and commissioning of the total facility. The supplier would provide the details of the room size required for the facility and complete layout drawings of the facility inside the room as a part of the technical offer. The system layout may be modified after consultation depending on the space and infrastructure available at IIP, Dehradun. The requirement for heating, ventilation and air conditioning for the equipments should be clearly specified.

Length of some of the components like exhaust pipe, heated line and connection pipes will depend on final layout of the system. The supplier shall consider all pipes, bends, electrical wires and any special features required for the facility as a part of the supply. IIP, Dehradun will only provide the points for the power supply, water supply and the compressed air for which the location and required quantity and pressure should be specified by the supplier in the layout drawing. The supplier shall be responsible for the complete installation, commissioning and successful operation run of the facility. All third party instruments should include operating manuals and circuit diagrams.
The facility shall consist of the following major equipments; however, all the components mentioned in other sections would be a part of the supply.

- Transient dynamometer with all accessories
- Automation system
- Fuel conditioning and measurement system
- Water coolant system
- Engine oil conditioning and Measurement system
- Engine intake air measurement system

- Temperature and pressure measurement system
- Opacimeter
- Exhaust back pressure system
- Exhaust gas analyzer system
- CVS system with all accessories and calibration equipment
- Full flow dilution tunnel with all accessories
- Test cell ventilation system
- Fresh air supply system
- Room exhaust system
- Engine exhaust disposal system
- Fuel supply system
- Combustion air conditioning system

3.0 A HIGH DYNAMIC TEST BED OR FULLY TRANSIENT TEST BED FOR HEAVY-DUTY DIESEL ENGINES

3.1 Transient Dynamometer

A High dynamic Test Bed or Fully Transient Test Bed (AC type) with cabinet for the supply and control, with zero inertia, hydrostatic bearing and with load cell for torque measurement should be offered. It is to be Complete with Drive System, Dynamometer control and engine data acquisition system. The dynamometer shall have frequency converter with mains filters for direct connection to the mains supply with current band control algorithm and digital real time interface.

Max. Power:	375 +/- 25 kW
Max. Torque:	1950 +/- 100 Nm
Max. Speed:	7500 +/- 500 RPM

Overall Torque Measurement Accuracy: +/- 0.05 % of the measured value

Overload Capacity: 25 % for 60 seconds

It should be possible to calibrate the dynamometer to half of its rating for testing small capacity engines with better accuracy.

Range of Engines to be tested (Diesel/Gasoline/Alcohol/CNG/LPG):

a). Heavy Duty Engines:

Power: 400 hp @ 1800 rpm and
Torque: 2000 Nm @ 1200 rpm

b). Passenger car engines: Power: 50-70 hp @ 4500-5500 rpm and
Torque: 85 Nm @ 2500 rpm

Power: 70-90 hp @ 6000–6500 rpm and
Torque: 120 Nm @ 4500 rpm

The offer shall include calibration system, calibration weight and dynamometer intermediate frame.

Dynamometer Controller and Monitoring Unit:

Dynamometer controller should be digital. The display of controller should provide both the demand and the actual valve. It shall be possible to achieve a torque control accuracy of +/- 0.1 % F.S and speed control accuracy of +/- 1 RPM.

3.2 Automation System

It shall have following features:

- **Freely programmable.**
- **Window based and user friendly software.**
- **The software to have facility to create own library function and save so that it can be used on any test run.**
- **Different user levels with password protection.**
- **Any type of analog input (pressure, temperature, current, voltage, strain, etc.) can be connected to any channel through the software.**
- **Individual channel acquisition rate for analog input selectable up to 200 Hz.**
- **Interfacing of devices like fuel meter, opacimeter, emission analyzer, CVS, full-flow tunnel, partial-flow tunnel, combustion air system, etc. shall be possible.**
- **It shall be possible to initiate the calibration of emission equipment and CVS system through the automation system. One shall be able to select individual range of each analyzer for calibration. Zero and span change shall be selectable through the software.**
- **The interface between the software and the transient dynamometer shall be through high speed intelligence.**
- **The emission cycle as per Euro-III and Euro IV norms (ESC, ELR, ETC) shall be performed using fully automatic and foolproof (user can not tamper/change the result or test run) software package and result/report shall be available as per legal format automatically at the end of the test. The Euro IV ETC test will be conducted either using full-flow tunnel or partial-flow tunnel. The legal software shall be offered for both types of particulate systems.**
- **The application software is required to be offered so that the calibration of any individual equipment defined in the legal procedure shall be performed automatically through automation system. After the test run, data shall be processed through this software and the results are printed indicating the status of the results. It shall clearly indicate wherever the test cycle is being violated. This implies that complete software for calibration, certification and result reporting should be offered.**

3.3 Throttle Actuator

A throttle actuator suitable for execution of legal driving cycles, i.e., ECE, FTP, EPA, IDC, etc. shall be included. Throttle Actuator unit shall be microprocessor based having Servo motor.

A Shifting Travel of 100 mm is required.
Maximum Shifting Force: 150 N.
A Shifting Speed of 500 mm/s is required.
Positional Repetitive Accuracy should be less than +/- 0.05 mm.
A digital controller with a monitoring function is required.
Manual and automatic adjustment of final throttle position via soft keys and a separate LC display in the engine test cell is to be included.

3.4 Cardan Shaft

6 nos. of Cardan shafts are to be provided for various engine capacities for connecting dynamometer to the engine. These cardan shafts should be suitable for the range of engines mentioned. Suitable protective guard should be provided.

3.5 Isolated Base Plate

An isolated base plate with air cushion having automatic level arrangement shall be offered. The natural frequency of the foundation block should not be more than 3 Hz.

3.6 Engine Mounting System

A flexible engine mounting system shall be offered facilitating problem free installation of various types of engines. The system should have flexibility in the x, y, z direction.

3.7 Fuel Conditioning and Measurement System

Fuel Conditioning for Liquid Fuels

The fuel conditioning system should be suitable for the range of engines mentioned in Section 3.1. This conditioning system should be suitable for liquid fuels, i.e., gasoline, diesel, alcohol, etc. Selection between 10 to 70 ^{0}C shall be possible and temperature stability should be +/- 0.02 ^{0}C. IIP Dehradun would be providing water at ambient temperatures. If chilled water is required, chiller should be a part of the offer.

Fuel Measurement System for Liquid Fuels

Fuel measurement system for liquid fuels, i.e., gasoline/diesel/alcohol shall be based on mass flow principle. The system should be suitable for the range of engines mentioned in Section 3.1. The following features shall be available.

- **Indication of fuel consumption in kg/h.**
- **Average consumption for on-line measurement of fuel.**
- **Total / interval consumption for determined measuring time.**
- **Running average calculation with additional indication of standard deviation and measurement uncertainty. Selection of nominal fuel temperature - analogue or via RS232.**
- **Measuring system shall be capable of short measurement time of 100 ms.**
- **Fully automatic built-in accuracy check and calibration.**
- **It shall have measuring accuracy of 0.1% of the measured value.**
- **Calibration system is also required to be offered for calibration of the liquid fuel measurement system.**

Fuel Measurement System for Gaseous Fuels

Fuel measurement system for gaseous fuels, i.e., CNG/LPG shall be based on mass flow principle. The system should be suitable for the range of engines mentioned in Section 3.1. Indication of fuel consumption should be in in kg/h.

3.8 Water Coolant Conditioning System

Independent water circulation system is required for cooling of 400 kW transient dynamometer.

- **Engine cooling: The engine water coolant conditioning system shall be suitable up to 400 kW engine and the outlet water shall be conditioned and set at desired temperature for example at 80±2 °C.**

The system shall consist of storage tank, water circulation pumps, valves, etc. and cooling tower of suitable capacity, GI piping etc. There shall be no leakage in the line and the system shall be tested for 10 bar pressure for leakages. All components used in the system shall be corrosion resistant. IIP Dehradun would be providing water at ambient temperatures. If chilled water is required, chiller should be a part of the offer.

The offer shall also include heater for initial heating of coolant.

3.9 Engine Oil Conditioning and Measurement System

The engine oil should be conditioned and temperature maintained at the desired level with an accuracy of +/- 1 ºC. The oil conditioning and measurement system shall be suitable up to 400 kW diesel engines. IIP Dehradun would be providing water at ambient temperatures. If chilled water is required, chiller should be a part of the offer. The engine oil consumption should be measured on gravimetric basis in g/h.

The offer shall also include heater for initial heating of the oil.

3.10 Engine Intake Air Measurement System

A dynamic air mass flow meter for direct mass flow measurement of intake engine air is required. It should have a rapid response to flow changes and a wide measurement range with high accuracy.

Accuracy of the air mass flow meter should be +/- 1 % of measured value
Measuring Range: 0-2400 kg/h

3.11 Temperature and Pressure Measurement Facility

Total 15 nos. of temperature sensors should be supplied. Out of these, there shall be five sensors for temperature measurement of 0-150 °C and ten sensors for temperature measurement of 0-1000 °C. The supplier will mount the sensors in all temperature measurement locations as per requirement of the regulation. Remaining sensors out of the total 15 sensors will be supplied as additional sensors.

Accuracy:

0.5 °C accuracy for a temperature sensor of 0-150 °C
1.5 °C accuracy for a temperature sensor of 0-1000 °C

Connecting cable should have sufficient length for use within the transient test cell.

Total 15 nos. of pressure measurement sensors should be provided. Out of these, there shall be six sensors for pressure of 0 to 2 bars, two sensors for pressure of 0 to 6 bar and 7 sensors for pressure of max.10 bar. The supplier will mount the sensors in all pressure measurement locations as per requirement of the regulation. Remaining sensors, out of the total 15 sensors, will be supplied as additional sensors.

The offer shall also include Barometric pressure and Relative Humidity sensor.

Specifications for the pressure transducer:

Data acquisition rate in steps from 5Hz to 1000 Hz is required

Digital temperature compensation from –25 °C to +80 °C is required

Total error: +/- 0.1 % Full Scale / -25 °C to +80 °C

3.12 Opacimeter

Opacimeter for ELR test for statutory requirements of EURO III & IV. This opacimeter is to be used both on engine test bed and chassis dynamometer. Facility for automatic calibration and automatic programs for measurement are required.

Measurement value resolution:
0.1 % opacity

Zero Drift:
0.1 % opacity/ 30 min.

Opacimeter Display and Range:
For display in opacity, the range should be 0-100 % opacity, and the readability 0.1 % opacity. For display in light absorption coefficient, the range should be 0-30 m^{-1} light absorption coefficient, and the readability 0.01 m^{-1} light absorption coefficient
Sampling rate for opacity signal: 50 Hz
Instrument Response Time:

The physical response time of the opacimeter shall not exceed 0.2 s. [where the physical response time is the difference between the times when the output of a rapid response receiver reaches 10 and 90 % of the full deviation when the opacity of the gas being measured is changed in less than 0.1 second.]

The electrical response time of the opacimeter shall not exceed 0.05 s. [where the electrical response time is the difference between the times when the opacimeter output reaches 10 and 90 % of the full scale when the light source is interrupted or completely extinguished in less than 0.01 second].

Exhaust Gas Temperature: 0 to 600 ^{o}C

Display Unit:

It should have a display unit for display of the measuring value, pre-selection of measuring mode and setting of instrument parameters. Error shall also be displayed.

3.13 Exhaust Back pressure system

The system shall be connected before opacimeter and after sampling point and it shall be suitable for transient cycles. It should include required PID controller, pressure transmitter and chamber to adjust exhaust back pressure.

3.14 Test cell ventilation system

System shall be designed for the test cell consisting of 400 kW transient dynamometer, engines and sub-systems and should meet all the regulatory requirements. Ambient temperatures to be considered are 5 deg. Celsius minimum and 45 deg. Celsius maximum. During operation, the test cell temperature shall be maintained as required by the regulation. The system shall consider fresh air supply, room exhaust and engine exhaust disposal. The supplier shall include technical details of all the equipments proposed to be used in the system along with schematic flow diagram.

3.15 Fresh air supply system

Filtered and cooled air, as required by the regulation, shall enter the test cell and hot air is to be ventilated to the atmosphere. System shall consist of

- **Air filter assembly**
- **Air blower**
- **Ducting, dampers, supply grills**

Ducting shall be of GI sheet duly insulated by mineral wool and Aluminum cladding. Scope of supply shall include Design, Supply, Installation & commissioning.

3.16 Room Exhaust System

Hot air from the test cell is to be removed by the blower. Based on the quantity of fresh air supply, the capacity of the room exhaust blower is to be decided. The location of the suction grill shall be on the opposite side of the fresh air supply grill to have cross flow. The system shall consist of blower, suction grills and ducting. The scope of work includes design, supply, installation & commissioning.

3.17 Engine Exhaust Disposal System

The exhaust of the running engine is to be vented to the atmosphere. Engine exhaust is to be taken out just above the test cell. System shall consist of blower and M.S. ducting. The part of the ducting within the building shall be insulated.

3.18 Fuel Supply System

Fuel supply system has to be offered both for liquid and gaseous fuels. Separate arrangement should also be made for reference fuel and commercial fuel. Supplier shall consider all the items required, from the fuel supply tank/cylinder to the point of entry to the fuel measuring system.

Supplier shall include complete technical details of all the equipments proposed to be used in the fuel supply system. Schematic flow diagram and point wise technical details are to be provided. Scope of supply shall consist of design, supply, installation, testing and commissioning.

3.19 Training, Commissioning and Spare Parts

3.19.1 Pre-acceptance

The transient dynamometer would be inspected at the manufacturer's premises before packing. After checking test reports of individual items and physical inspection, acceptance would be given. For this purpose, one scientist of the Indian Institute of Petroleum would be deputed. The charges for this for one person for about two weeks should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, lodging, boarding and daily allowance, etc.

3.19.2 Operation and Maintenance Training

Equipment operation and maintenance training is required for the transient dynamometer for one person of Indian Institute of Petroleum at the manufacturer's premises before shipment of the transient dynamometer. The charges for this training for one person for about two weeks should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, boarding and daily allowance, etc.

3.19.3 Installation and Commissioning at IIP Dehradun

The installation and commissioning of the equipment at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment.

3.19.4 Spares and Consumable Parts

The spares and consumable parts required for the equipments for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned.

4.0 FULL-FLOW PARTICULATE TUNNEL FOR HEAVY-DUTY DIESEL ENGINES ALONG WITH CVS SYSTEM

4.1 Constant Volume Sampler

This should be for dilute/bag and particulate measurement through tunnel. CVS shall be interfaced with transient dynamometer control system. The system should meet all requirements of Directive 2005/78/EC of 14 November 2005 amended from 2005/55/EC for the measurement of emissions of gaseous and particulate pollutants from diesel

engines from EURO III & IV emission norms and should also meet the requirements of US heavy-duty 2007 test procedure.

The flow rate will be controlled by a CFV (Critical Flow Venturi).

The flow rate of the diluted emission gas will be measured by a CFV unit with flow rate of up to 120 m^3/min.

Number of CFV: Four venturies, which can be individually switched or in combination (our requirement of measurement of flow rate of 20, 40 and 50 m^3/min should be kept in mind while designing the system).

Venturi selection should be automatic.

CFV measurement accuracy: better than +/- 2% of reading.

System with Heat exchanger (HE) or automated flow compensation is required.

Gas mixture temperature ahead of CFV: Within +/- 1 K.

Volume and Airflow rate calculation and Correction required for 101.3 kPa, 273 K and 101.3 kPa, 293 K.

Temperature sensor accuracy: better than +/- 1 K.

Temperature sensor response: better than 0.5s at 62 % of input temperature.

Pressure sensor accuracy: better than +/-0.1 kPa.

Recommended thickness to diameter ratio 0.015 or less .

Recommend pipe diameter such that exhaust back pressure with and without CFV remains within +/- 1.5 kPa.

Dilution Air Filter: 3 stage with charcoal scrubber.

Host interface for CVS controller is required.

Sampling Bags

3 for Diesel, 3 for Gasoline/Alternate Fuels, 3 for dilution air.
Bag capacity: minimum 90 litre.

Blower:

It should generate sufficient vacuum to choke the CFV and maintain sonic flow velocity under all operating conditions.

Suction flow rate: 120 m^3/min.
Blower Silencer noise level: less than 85 dB.

Filters and Sample lines

Heated filters are required as per the regulations.

Heated lines are required as per the regulation.

Selection between Diesel and Gasoline bag sampling: Automatic by CVS controller.

Separator

It is required to have separator to remove heavy contamination that is contained in the diluted exhaust such as rust, exhaust pipe parts, bits of catalyst etc.

Heat Exchanger

The heat exchanger will control the temperature of the CVS diluted exhaust gas as required by the regulation.

Fill bag sampling pump:

The pump should have enough power to keep proportionality between the sample gas and diluted exhaust gas in the main bulk stream.

Oil catcher:

To remove any oil mist from the sampling gas before it enters the bag.

Bleed-off valve

Bleed-off valve to protect the turbo blower from surge.

CVS calibration equipment

To calibrate the CVS system according to EPA and ECE requirement, i.e., LFE for CVS calibration upto 120 m^3/min, propane injection unit as required under the regulation. Calibration software should also be provided.

4.2 Dilution Tunnel

The system should meet requirements of the following test standards:

- **European Directive 2005/78/EC**
- **European Directive 2005/55/EC for Euro-III, IV transient test cycles like European Transient Cycle (ETC) and ESC**
- **ISO 16183 procedure using partial-flow tunnel**
- **EPA Cycles like US heavy duty transient cycle (FTP)**
- **US HD 2007**
- **Simulated Vehicle Cycles**
    - **EDC - EUDC**
    - **FTP-75**

The above description shows that a full-flow dilution tunnel and a partial-flow dilution tunnel for on-line particulate measurement during transient application, as per regulations would be required and should be considered as a part of the offer.

For full-flow dilution tunnel, 18″ stainless steel internally mirror finished dilution tunnel with all accessories should be provided. Standard floor mounted design is preferred. It

should have a double dilution system. Primary tunnel diameter should be at least 460 mm. Switch over between single and double dilution should be automatic. Dilution air cooler to provide air at 25+/-5 ºC should be offered and it should be air cooled system. No chilled water will be provided by IIP.

Partial-flow particulate system shall also be offered. This should have filter panel with 3 filter holders meeting the specifications as defined in ISO 16183 for use of partial-flow system for Euro IV, ETC test. It should have T_{50} time of less than 300 ms so that it can be used for online particulate measurement. Dilution air cooler is also required to be offered so that dilution air can be supplied between 20 to 30 ^{o}C. IIP will not be providing any chilled water for a dilution air cooler and if chiller is required, it should be included as a part of the offer.

4.2.1 Particulate Sampler

Secondary Dilution Tunnel

Secondary tunnel diameter: suitable to meet all requirements of the regulation

Size: At least 75 mm Length to have residence time at least 0.25 s

Dilution Air Cooler Required

Dilution sampler for diesel PM based on precision venturi or mass flow controller for variable flow shall be provided. It shall have following features:

- **PM sampling flow: 65 – 100 litre/min. Flow through filter holders settable to get minimum filter loading of 0.5 mg/1075 mm^2, within the range of gas face velocity 35 to 80 cm/s**
- **Background air sampling as per EPA requirement**
- **Particulate probe diameter: 12 mm minimum inside diameter, type ECE and EPA both required, Selection of probe shall be automatic.**
- **Particulate transfer tube length shall be as per regulation.**
- **Temperature sensor accuracy better than +/-1 K**
- **Host interface**

4.2.2 Particulate Weighing Chamber and Analytical Balance for Particulate Measurement

Particulate weighing chamber should be offered as per regulation including the temperature calibration equipment. The weighing balance should have accuracy as required by the regulation.

The temperature of the chamber in which the particulate filters would be conditioned and weighed is to be maintained within 295 K ±3 K (22 °C ± 3 °C) during all filter conditioning and weighing. The humidity shall be maintained to a dew point of 282.5 K ± 3 K (9.5 °C ± 3 °C) and a relative humidity of 45 % ± 8 %.

The analytical balance used to determine the weights of all filters is to have a precision (standard deviation) of 20 μg and a resolution of 10 μg (1 digit = 10 μg). For filters less than 70 mm diameter, the precision and resolution shall be 2 μg and 1 μg, respectively.

4.3 Training, Commissioning and Spare Parts

4.3.1 Pre-acceptance

The particulate measurement system along with CVS would be inspected at the manufacturer's premises before packing. After checking test reports of individual items and physical inspection, acceptance would be given. For this purpose, one scientist of the Indian Institute of Petroleum would be deputed. The charges for this for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, lodging, boarding and daily allowance, etc.

4.3.2 Operation and Maintenance Training

Equipment operation and maintenance training is required for the particulate measurement system along with CVS for one person of Indian Institute of Petroleum at the manufacturer's premises before shipment of the equipment. The charges for this training for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, boarding and daily allowance, etc.

4.3.3 Installation and Commissioning at IIP Dehradun

The installation and commissioning of the equipments at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment.

4.3.4 Spares and Consumable Parts

The spares and consumable parts required for the equipments for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned.

5.0 EMISSION GAS ANALYZER FOR GASOLINE/DIESEL/ALCOHOL/ CNG/LPG ENGINES EQUIPPED WITH EMISSION CONTROLLED DEVICES

5.1 Analyzer Type

The Emission Gas Analyzer for Gasoline/Diesel/Alcohol/CNG/LPG Engines Equipped with Emission Controlled Devices shall be capable of measuring EGR Raw Exhaust, Raw Exhaust Pre-Cat, Raw Exhaust Post-Cat and ESC Sampling Line and ETC Raw Line, Diluted Exhaust Measurement, and hot continuous measurement close to dilution tunnel. Calculation of catalytic converter efficiency and particulate trap evaluation shall be included. The analyzer lines would be as follows:

Line 1 : Raw Exhaust Pre and Post Cat including Raw EGR

This will consist of THC FID & CH4 Cut FID, NOx CLD, CO-high, CO-low NDIR, CO2 NDIR and O2 PMO. The system should be capable of measuring on-line raw exhaust.

Line 2 : Diluted Exhaust

This will consist of THC FID & CH4 Cut FID, NOx CLD, CO-high, CO-low NDIR, CO2 NDIR and O2 PMO.

Line 3 : Hot Continuous Measurement Close to Dilution Tunnel

This will consist of HTHC FID & CH4 Cut FID, HNOx CLD.

Emission Gas Analyzer along with the Full-Flow and Partial-Flow Dilution Particulate Measurement System should meet requirements of following test standards:

- **European Directive 2005/78/EC**
- **European Directive 2005/55/EC for Euro-III, IV Transient test cycles like European Transient Cycle (ETC) and ESC**
- **EPA Cycles like US heavy duty transient cycle (FTP)**
- **ISO 16183 using partial-flow tunnel**
- **US HD 2007**
- **Simulated Vehicle Cycles**
  - **EDC - EUDC**
  - **FTP-75**
- **System shall measure 13-mode diesel emissions and 8-mode diesel emissions from off-road engines**
- **The system should be able to measure catalytic converter efficiency like D-NOx Catalyst and also efficiency of particulate traps.**

5.2 Analyzer Ranges

Component	CO(L)	CO(H)/CO_2	O_2
Range	0-50-5000 ppm	CO 0-0.5-12% CO_2 0-0.5-20%	O_2 0-1-25%
Repeatability (zero)	<±0.5% FS	<±0.5% FS	<±0.5% FS
Repeatability (span)	<±0.5% RS	<±0.5% RS	<±0.5% RS
Drift (Zero)	(>100ppm)<±1%FS/24 h (50-100ppm) <±1%FS/24h	<±1%FS/h	<±1%FS/h
Drift(span)	(>50ppm) <±1%FS/24h	<±1%FS/h	<±1%FS/h
Noise	<±1%FS	<±1%FS	<±1%FS
Linearity	<±1%FS or <±2%RS	<±1%FS or <±2%RS	<±1%FS or <±2%RS
T90	(<100ppm)< 3 sec (>100ppm)< 2 sec	<1.5 sec	<2 sec
Sample flow rate	3 l/min	2 l/min	0.7 l/min

Component	CH_4 cutter type	NOx	THC
Range (DSR)	0-5-50ppm 0-100-250ppm	0-10-500ppm 0-1000-10000ppm	0-10-500ppm 0-1000-50000ppm
Repeatability (zero)	<±0.5% FS	<±0.5% FS	<±0.5% FS
Repeatability (span)	<±0.5% RS	<±0.5% RS	<±0.5% RS
Drift (Zero)	<±1%FS/24h	<±0.5%FS/24h	<±1%FS/24h
Drift(span)	<±2%FS/24h	<±0.5%FS/24h	<±1%FS/24h
Noise	None	<±2%FS	<±1%FS
Linearity	<±1%FS or <±2%RS	<±1%FS or <±2%RS	<±1%FS or <±2%RS
T90	15±1 sec	NO: within 1.5 sec NOx: within 2.0 sec	<1.5sec
Sample flow rate	0.5 l/min	0.5 l/min	2.0 l/min

5.3 Analyzer Special Functions

The analyzer shall have following special functions:

- **Automatic calibration**
  - **For direct measurement and for CVS measurement (for Dilute/Bag measurement**
- **Touch screen**
- **0 to 10 V analog output for all measured channels or digital data recorder**
- **External gas divider (critical orifice type for better accuracy), minimum 20 points, accuracy better than 0.5 %.**
- **Span Gas Selector for 4 span gases per component (CO2 and O2, 2 span gases)**
- **Line leak checker**
- **Interference checker for CO_{low} analyzer**
- **NOx quenching check**
- **Power cable**
- **Interconnecting cables & LAN cables.**

5.4 Training, Commissioning and Spare Parts

5.4.1 Pre-acceptance

The emission gas analyzer system would be inspected at the manufacturer's premises before packing. After checking test reports of individual items and physical inspection, acceptance would be given. For this purpose, one scientist of the Indian Institute of Petroleum would be deputed. The charges for this for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, lodging, boarding and daily allowance, etc.

5.4.2 Operation and Maintenance Training

Equipment operation and maintenance training is required for the emission gas analyzer system for one person of Indian Institute of Petroleum at the manufacturer's premises before shipment of the emission gas analyzer system. The charges for this training for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, boarding and daily allowance, etc.

5.4.3 Installation and Commissioning at IIP Dehradun

The installation and commissioning of the equipments at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment.

5.4.4 Spares and Consumable Parts

The spares and consumable parts required for the equipments for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned.

6.0 CONDITIONED AIR SUPPLY FOR DIESEL ENGINES

The inlet air given to the engine shall be temperature, pressure and humidity conditioned. The unit shall be suitable for Euro-III and Euro-IV, ESC, ELR, ETC application. System shall be supplied with Hot wire type air flow measuring system. The unit shall be compact and mobile and the specifications are given below:

- **Air flow: 60-2400 m ^{3}/h. If the combustion air generator is also used for supply of the CVS dilution air and separate arrangement is not made for the same, the flow will be 9,600 m ^{3}/h**
- **Adjustable air temperature: 20-30 deg Celsius**
- **Adjustable intake air pressure: Ambient to 100 kPa**
- **Adjustable air humidity: 30 –70 % RH**
- **Accuracy:**
  - **Temperature: + 0.5 deg Celsius**
  - **Pressure : + 1 kPa**

Response time: Suitable for transient cycles.

6.1 Spare Parts, Commissioning and Operation Training

6.1.1 Spares and Consumable Parts

The spares and consumable parts required for the equipment for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned.

6.1.2 Installation, Commissioning and Operation Training

The installation and commissioning of the equipment at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the

manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment.

7.0 EXPERIENCE AND AFTER SALES SERVICE

The supplier offering the system should have supplied at least three Heavy-duty Transient Test Beds in India during last 3 years. They should have a service centre in India and trained personnel for after-sales service. The supplier shall also give an undertaking that supply of spare parts for the system would be insured for at least ten years.

8.0 OPTIONAL ITEMS

The supplier is required to quote following additional items separately.

8.1 Engine Combustion Analysis System

An engine combustion analysis, high speed data acquisition, system, suitable for the range of engines mentioned in Section 3.1 may be offered as an optional item and quoted separately.

8.2 Vehicle Simulation Software

Vehicle simulation software to simulate vehicle cycles like EDC-EUDC, FTP 75, etc. on the transient test bed may be offered as an optional item and quoted separately.

The software should be capable to take test data of vehicle and to run on the transient dynamometer for development and optimization work.

It should be capable of simulation for as follows;

- Vehicle performance testing
- Pre-tuning of electronic control units and pre-calibration in engine test cells
- Dynamic engine performance with simulation of vehicle and driver
- Realistic durability testing that replicated vehicle behavior.

9.0 TABLES OF SUPPLIER'S RESPONSE

The supplier is required to fill up the following table and clearly mention his commitment to meet the IIP's requirements/specifications. Deviations, if any should be clearly mentioned and adequately explained, if required. This table is in addition to the detailed specifications along with the manufacturer's leaflets and brochures, etc.

S.No.	IIP's Requirements/Specifications	Response of the Supplier
1	**PREAMBLE** This facility is required for mass emission measurement from heavy-duty engines using transient engine dynamometer as per Bharat stage III/IV, US heavy-duty 2007 and European emission norms. The facility shall be in accordance with the European Directive 2005/78/EC amended from 2005/55/EC for the measurement of emissions of gaseous and particulate pollutants from diesel engines from EURO III & IV emission norms and should also meet the requirements of US heavy-duty 2007 test procedure. All the components, hardware and software shall be included in the offer to comply as per European Directive 2005/78/EC and 2005/55/EC for heavy-duty engines operating on diesel, gasoline, CNG, LPG and alcohol fuels. The facility should be capable of following Indian, U.S. and European, legal cycles, legal certification calculations and regression analysis, etc. as required by the regulations for heavy-duty engines mass emission measurements. The system should be upgradeable to Euro-V requirements, whenever required. The facility should be designed keeping in view the Indian electrical supply conditions. The voltage supply available is 220 V, single phase and 400 V, 3 phase with 50 Hz frequency. The system should be able to tolerate 10 % fluctuation in the voltage. IIP would be providing water at ambient temperatures and if chilled water is required for engine coolant, oil conditioning, fuel conditioning, engine intake air conditioning, particulate system etc., chillers required should be a part of the offer. The facility should be complete in all respects as detailed in the subsequent sections.	

2	**SCOPE OF SUPPLY** The supplier will be completely responsible for the system layout and its supervision during installation and commissioning of the total facility. The supplier would provide the details of the room size required for the facility and complete layout drawings of the facility inside the room as a part of the technical offer. The system layout may be modified after consultation depending on the space and infrastructure available at IIP, Dehradun. The requirement for heating, ventilation and air conditioning for the equipments should be clearly specified. Length of some of the components like exhaust pipe, heated line and connection pipes will depend on final layout of the system. The supplier shall consider all pipes, bends, electrical wires and any special features required for the facility as a part of the supply. IIP, Dehradun will only provide the points for the power supply, water supply and the compressed air for which the location and required quantity and pressure should be specified by the supplier in the layout drawing. The supplier shall be responsible for the complete installation, commissioning and successful operation run of the facility. All third party instruments should include operating manuals and circuit diagrams. The facility shall consist of the following major equipments; however, all the components mentioned in other sections would be a part of the supply. • Transient dynamometer with all accessories • Automation system • Fuel conditioning and measurement system • Water coolant system • Engine oil conditioning and Measurement system • Engine intake air measurement system • Temperature and pressure measurement system • Opacimeter • Exhaust back pressure system • Exhaust gas analyzer system • CVS system with all accessories and calibration equipment • Full flow dilution tunnel with all accessories • Test cell ventilation system	

	• Fresh air supply system • Room exhaust system • Engine exhaust disposal system • Fuel supply system • Combustion air conditioning system	
3	**A HIGH DYNAMIC TEST BED OR FULLY TRANSIENT TEST BED FOR HEAVY-DUTY DIESEL ENGINES** **Transient Dynamometer** A High dynamic Test Bed or Fully Transient Test Bed (AC type) with cabinet for the supply and control, with zero inertia, hydrostatic bearing and with load cell for torque measurement should be offered. It is to be Complete with Drive System, Dynamometer control and engine data acquisition system. The dynamometer shall have frequency converter with mains filters for direct connection to the mains supply with current band control algorithm and digital real time interface. The harmonics distortion should be less than 5 %. Max. Power: 350-400 kW Max. Torque: 1850-2000 Nm Max. Speed: 7000-8000 RPM Overall Torque Measurement Accuracy: +/- 0.05 % of the measured value Overload Capacity: 25 % for 60 seconds It should be possible to calibrate the dynamometer to half of its rating for testing small capacity engines with better accuracy. Vibration level of the dynamometer with engine running should be less than 7 mm/s. **Range of Engines to be tested (Diesel/Gasoline/Alcohol/CNG/LPG):** a). Heavy Duty Engines: Power: 400 hp @ 1800 rpm and Torque: 2000 Nm @ 1200 rpm b). Passenger car engines: Power: 50-70 hp @ 4500-5500 rpm and Torque: 85 Nm @ 2500 rpm Power: 70-90 hp @ 6000–6500 rpm and **Torque: 120 Nm @ 4500 rpm**	

	The offer shall include calibration system, calibration weight and dynamometer intermediate frame. Dynamometer Controller and Monitoring Unit: **Dynamometer controller should be digital. The display of controller should provide both the demand and the actual valve. It shall be possible to achieve a torque control accuracy of +/- 0.1 % F.S and speed control accuracy of +/- 1 RPM.**	
4	Automation System **It shall have following features:** • **Freely programmable.** • **Window based and user friendly software.** • **The software to have facility to create own library function and save so that it can be used on any test run.** • **Different user levels with password protection.** • **Any type of analog input (pressure, temperature, current, voltage, strain, etc.) can be connected to any channel through the software.** • **Individual channel acquisition rate for analog input selectable up to 200 Hz.** • **Interfacing of devices like fuel meter, opacimeter, emission analyzer, CVS, full-flow tunnel, partial-flow tunnel, combustion air system, etc. shall be possible.** • **It shall be possible to initiate the calibration of emission equipment and CVS system through the automation system. One shall be able to select individual range of each analyzer for calibration. Zero and span change shall be selectable through the software.** • **The interface between the software and the transient dynamometer shall be through high speed intelligence.** • **The emission cycle as per Euro-III and Euro IV norms (ESC, ELR, ETC) shall be performed using fully automatic and foolproof (user can**	

	not tamper/change the result or test run) software package and result/report shall be available as per legal format automatically at the end of the test. The Euro IV ETC test will be conducted either using full-flow tunnel or partial-flow tunnel. The legal software shall be offered for both types of particulate systems. The application software is required to be offered so that the calibration of any individual equipment defined in the legal procedure shall be performed automatically through automation system. After the test run, data shall be processed through this software and the results are printed indicating the status of the results. It shall clearly indicate wherever the test cycle is being violated. This implies that complete software for calibration, certification and result reporting should be offered.	
5	**Throttle Actuator** A throttle actuator suitable for execution of legal driving cycles, i.e., ECE, FTP, EPA, IDC, etc. shall be included. Throttle Actuator unit shall be microprocessor based having Servo motor. A Shifting Travel of 100 mm is required. Maximum Shifting Force: 150 N. A Shifting Speed of 500 mm/s is required. Positional Repetitive Accuracy should be less than +/- 0.05 mm. A digital controller with a monitoring function is required. Manual and automatic adjustment of final throttle position via soft keys and a separate LC display in the engine test cell is to be included.	
6	Cardan Shaft 6 nos. of Cardan shafts are to be provided for various engine capacities for connecting dynamometer to the engine. These cardan shafts should be suitable for the range of engines mentioned. Suitable protective guard should be provided.	

7	**Isolated Base Plate** An isolated base plate with air cushion having automatic level arrangement shall be offered. The natural frequency of the foundation block should not be more than 3 Hz.	
8	**Engine Mounting System** A flexible engine mounting system shall be offered facilitating problem free installation of various types of engines. The system should have flexibility in the x, y, z direction.	
9	**Fuel Conditioning and Measurement System** **Fuel Conditioning for Liquid Fuels** The fuel conditioning system should be suitable for the range of engines mentioned in Section 3.1. This conditioning system should be suitable for liquid fuels, i.e., gasoline, diesel, alcohol, etc. Selection between 10 to 70 ^{0}C shall be possible and temperature stability should be +/- 0.02 ^{0}C. IIP Dehradun would be providing water at ambient temperatures. If chilled water is required, chiller should be a part of the offer. **Fuel Measurement System for Liquid Fuels** Fuel measurement system for liquid fuels, i.e., gasoline/diesel/alcohol shall be based on mass flow principle. The system should be suitable for the range of engines mentioned in Section 3.1. The following features shall be available. • **Indication of fuel consumption in kg/h.** • **Average consumption for on-line measurement of fuel.** • **Total/interval consumption for determined measuring time.** • **Running average calculation with additional indication of standard deviation and measurement uncertainty. Selection of nominal fuel temperature - analogue or via RS232.** • **Measuring system shall be capable of short measurement time of 100 ms.**	

	• **Fully automatic built-in accuracy check and calibration.** • **It shall have measuring accuracy of 0.1 % of the measured value.** • **Calibration system is also required to be offered for calibration of the liquid fuel measurement system.** **Fuel Measurement System for Gaseous Fuels** Fuel measurement system for gaseous fuels, i.e., CNG/LPG shall be based on mass flow principle. The system should be suitable for the range of engines mentioned in Section 3.1. Indication of fuel consumption should be in in kg/h.	
10	**Water Coolant Conditioning System** Independent water circulation system is required for cooling of 400 kW transient dynamometer. • **Engine cooling: The engine water coolant conditioning system shall be suitable up to 400 kW engine and the outlet water shall be conditioned and set at desired temperature for example at 80±2 °C.** The system shall consist of storage tank, water circulation pumps, valves, etc. and cooling tower of suitable capacity, GI piping etc. There shall be no leakage in the line and the system shall be tested for 10 bar pressure for leakages. All components used in the system shall be corrosion resistant. IIP Dehradun would be providing water at ambient temperatures. If chilled water is required, chiller should be a part of the offer. The offer shall also include heater for initial heating of coolant.	
11	**Engine Oil Conditioning and Measurement System** The engine oil should be conditioned and temperature maintained at the desired level with an accuracy of +/- 1 ºC. The oil conditioning and measurement system shall be suitable up to 400 kW diesel engines. IIP Dehradun would be providing water at ambient temperatures. If chilled water is required, chiller should be a part of the offer. The	

	engine oil consumption should be measured on gravimetric basis in g/h. The offer shall also include heater for initial heating of the oil.	
12	**Engine Intake Air Measurement System** A dynamic air mass flow meter for direct mass flow measurement of intake engine air is required. It should have a rapid response to flow changes and a wide measurement range with high accuracy. Accuracy of the air mass flow meter should be +/- 1 % of measured value Measuring Range: 0-2400 kg/h	
13	**Temperature and Pressure Measurement Facility** Total 15 nos. of temperature sensors should be supplied. Out of these, there shall be five sensors for temperature measurement of 0-150 °C and ten sensors for temperature measurement of 0-1000 °C. The supplier will mount the sensors in all temperature measurement locations as per requirement of the regulation. Remaining sensors out of the total 15 sensors will be supplied as additional sensors. Accuracy: 0.5 °C accuracy for a temperature sensor of 0-150 °C 1.5 °C accuracy for a temperature sensor of 0-1000 °C Connecting cable should have sufficient length for use within the transient test cell. Total 15 nos. of pressure measurement sensors should be provided. Out of these, there shall be six sensors for pressure of 0 to 2 bars, two sensors for pressure of 0 to 6 bar and 7 sensors for pressure of max.10 bar. The supplier will mount the sensors in all pressure measurement locations as per requirement of the regulation. Remaining sensors, out of the total 15 sensors, will be supplied as additional sensors. The offer shall also include Barometric pressure and Relative Humidity sensor. Specifications for the pressure transducer:	

	Data acquisition rate in steps from 5Hz to 1000 Hz is required Digital temperature compensation from –25 °C to +80 °C is required Total error: +/- 0.1 % Full Scale / -25 °C to + 80 °C	
14	**Opacimeter** Opacimeter for ELR test for statutory requirements of EURO III & IV. This opacimeter is to be used both on engine test bed and chassis dynamometer. Facility for automatic calibration and automatic programs for measurement are required. Measurement value resolution: 0.1 % opacity Zero Drift: 0.1 % opacity/ 30 min. Opacimeter Display and Range: For display in opacity, the range should be 0-100 % opacity, and the readability 0.1 % opacity. For display in light absorption coefficient, the range should be 0-30 m^{-1} light absorption coefficient, and the readability 0.01 m^{-1} light absorption coefficient Sampling rate for opacity signal: 50 Hz Instrument Response Time: The physical response time of the opacimeter shall not exceed 0.2 second. [where the physical response time is the difference between the times when the output of a rapid response receiver reaches 10 and 90 % of the full deviation when the opacity of the gas being measured is changed in less than 0.1 second.] The electrical response time of the opacimeter shall not exceed 0.05 second. [where the electrical response time is the difference between the times when the opacimeter output reaches 10 and 90 % of the full scale when the light source is interrupted or completely extinguished in less than 0.01 second]. Exhaust Gas Temperature: 0 to 600 ^{o}C Display Unit: It should have a display unit for display of the measuring value, pre-selection of measuring mode and setting of instrument parameters. Error shall also be displayed.	

15	**Exhaust Back pressure system** The system shall be connected before opacimeter and after sampling point and it shall be suitable for transient cycles. It should include required PID controller, pressure transmitter and chamber to adjust exhaust back pressure at the same level as intake.	
16	**Test cell ventilation system** **System shall be designed for the test cell consisting of 400 kW transient dynamometer, engines and sub-systems and should meet all the regulatory requirements. Ambient temperatures to be considered are 5 deg. Celsius minimum and 45 deg. Celsius maximum. During operation, the test cell temperature shall be maintained as required by the regulation. The system shall consider fresh air supply, room exhaust and engine exhaust disposal. The supplier shall include technical details of all the equipments proposed to be used in the system along with schematic flow diagram.**	
17	**Fresh air supply system** **Filtered and cooled air, as required by the regulation, shall enter the test cell and hot air is to be ventilated to the atmosphere. System shall consist of** • **Air filter assembly** • **Air blower** • **Ducting, dampers, supply grills** Ducting shall be of GI sheet duly insulated by mineral wool and Aluminum cladding. Scope of supply shall include Design, Supply, Installation & commissioning.	
18	**Room Exhaust System** Hot air from the test cell is to be removed by the blower. Based on the quantity of fresh air supply, the capacity of the room exhaust blower is to be decided. The location of the suction grill shall be on the opposite side of the fresh air supply grill to have cross flow. The system shall consist of blower, suction grills and ducting. The scope of work	

	includes design, supply, installation & commissioning.	
19	**Engine Exhaust Disposal System** The exhaust of the running engine is to be vented to the atmosphere. Engine exhaust is to be taken out just above the test cell. System shall consist of blower and M.S. ducting. The part of the ducting within the building shall be insulated.	
20	**Fuel Supply System** Fuel supply system has to be offered both for liquid and gaseous fuels. Separate arrangement should also be made for reference fuel and commercial fuel. Supplier shall consider all the items required, from the fuel supply tank/cylinder to the point of entry to the fuel measuring system. Supplier shall include complete technical details of all the equipments proposed to be used in the fuel supply system. Schematic flow diagram and point wise technical details are to be provided. Scope of supply shall consist of design, supply, installation, testing and commissioning.	
21	**Training, Commissioning and Spare Parts** **Pre-acceptance** The transient dynamometer would be inspected at the manufacturer's premises before packing. After checking test reports of individual items and physical inspection, acceptance would be given. For this purpose, one scientist of the Indian Institute of Petroleum would be deputed. The charges for this for one person for about two weeks should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, lodging, boarding and daily allowance, etc. **Operation and Maintenance Training** Equipment operation and maintenance training is required for the transient dynamometer for one person of Indian Institute of Petroleum at the manufacturer's premises before shipment of the transient dynamometer. The charges for this training	

	for one person for about two weeks should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, boarding and daily allowance, etc. **Installation and Commissioning at IIP Dehradun** The installation and commissioning of the equipment at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment. **Spares and Consumable Parts** ***The spares and consumable parts required for the equipments for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned.***	
22	**FULL-FLOW PARTICULATE TUNNEL FOR HEAVY-DUTY DIESEL ENGINES ALONG WITH CVS SYSTEM** **Constant Volume Sampler** This should be for dilute/bag and particulate measurement through tunnel. CVS shall be interfaced with transient dynamometer control system. The system should meet all requirements of Directive 2005/78/EC of 14 November 2005 amended from 2005/55/EC for the measurement of emissions of gaseous and particulate pollutants from diesel engines from EURO III & IV emission norms and should also meet the requirements of US heavy-duty 2007 test procedure. The flow rate will be controlled by a CFV (Critical Flow Venturi). The flow rate of the diluted emission gas will be	

	measured by a CFV unit with flow rate of up to 120 m^3/min. Number of CFV: Four venturies, which can be individually switched or in combination (our requirement of measurement of flow rate of 20, 40 and 50 m^3/min should be kept in mind while designing the system). Venturi selection should be automatic. CFV measurement accuracy: better than +/- 2 % of reading. System with Heat exchanger (HE) or automated flow compensation is required. Gas mixture temperature ahead of CFV: Within +/- 1 K. Volume and Airflow rate calculation and Correction required for: 101.3 kPa, 273 K and 101.3 kPa, 293 K. Temperature sensor accuracy: better than +/- 1 K. Temperature sensor response: better than 0.5s at 62% of input temperature. Pressure sensor accuracy: better than +/-0.1 kPa. Recommended thickness to diameter ratio 0.015 or less . Recommend pipe diameter such that exhaust back pressure with and without CFV remains within +/- 1.5 kPa. Dilution Air Filter: 3 stage with charcoal scrubber. Host interface for CVS controller is required. **Sampling Bags** 3 for Diesel, 3 for Gasoline/Alternate Fuels, 3 for dilution air. Bag capacity: minimum 90 ltr. **Blower:** It should generate sufficient vacuum to choke the CFV and maintain sonic flow velocity under all operating conditions.	

	Suction flow rate: 120 m^3/min. Blower Silencer noise level: less than 85 dB. *Filters and Sample lines* ***Heated filters are required as per the regulations.*** ***Heated lines are required as per the regulation.*** ***Selection between Diesel and Gasoline bag sampling: Automatic by CVS controller.*** **Separator** It is required to have separator to remove heavy contamination that is contained in the diluted exhaust such as rust, exhaust pipe parts, bits of catalyst etc. **Heat Exchanger** The heat exchanger will control the temperature of the CVS diluted exhaust gas as required by the regulation. **Fill bag sampling pump:** The pump should have enough power to keep proportionality between the sample gas and diluted exhaust gas in the main bulk stream. **Oil catcher:** To remove any oil mist from the sampling gas before it enters the bag. **Bleed-off valve** Bleed-off valve to protect the turbo blower from surge. **CVS calibration equipment** To calibrate the CVS system according to EPA and ECE requirement, i.e., LFE for CVS calibration upto 120 m3/min, propane injection unit as required under the regulation. Calibration software should also be provided.	

23	**Dilution Tunnel**
	
	The system should meet requirements of the following test standards:
	• **European Directive 2005/78/EC**
	• **European Directive 2005/55/EC for Euro-III, IV transient test cycles like European Transient Cycle (ETC) and ESC**
	• **ISO 16183 procedure using partial-flow tunnel**
	• **EPA Cycles like US heavy duty transient cycle (FTP)**
	• **US HD 2007**
	• **Simulated Vehicle Cycles**
	  ○ **EDC - EUDC**
	  ○ **FTP-75**
	The above description shows that a full-flow dilution tunnel and a partial-flow dilution tunnel for on-line particulate measurement during transient application, as per regulations would be required and should be considered as a part of the offer.
	
	For full-flow dilution tunnel, 18″ stainless steel internally mirror finished dilution tunnel with all accessories should be provided. Standard floor mounted design is preferred. It should have a double dilution system. Primary tunnel diameter should be at least 460 mm. Switch over between single and double dilution should be automatic. Dilution air cooler to provide air at 25+/-5º C should be offered and it should be air cooled system. No chilled water will be provided by IIP.
	
	Partial-flow particulate system shall also be offered. This should have filter panel with 3 filter holders meeting the specifications as defined in ISO 16183 for use of partial-flow system for Euro IV, ETC test. It should have T_{50} time of less than 300 ms so that it can be used for online particulate measurement. Dilution air cooler is also required to be offered so that dilution air can be supplied between 20 to 30 deg C. IIP will not be providing any chilled water for a dilution air cooler and if chiller is required, it should be included as a part of the offer.	

24	**Particulate Sampler** Secondary Dilution Tunnel	

	Secondary tunnel diameter: suitable to meet all requirements of the regulation Size: At least 75 mm Length to have residence time at least 0.25 s ***Dilution Air Cooler Required*** ***Dilution sampler for diesel PM based on precision venturi or mass flow controller for variable flow shall be provided. It shall have following features:*** • **PM sampling flow: 65 – 100 liter/min. Flow through filter holders settable to get minimum filter loading of 0.5 mg/1075 mm^2, within the range of gas face velocity 35 to 80 cm/s** • **Background air sampling as per EPA requirement** • **Particulate probe diameter: 12 mm minimum inside diameter, type ECE and EPA both required, Selection of probe shall be automatic.** • **Particulate transfer tube length shall be as per regulation.** • **Temperature sensor accuracy better than +/-1 K** • **Host interface**	
25	**Particulate Weighing Chamber and Analytical Balance for Particulate Measurement** Particulate weighing chamber should be offered as per regulation including the temperature calibration equipment. The weighing balance should have accuracy as required by the regulation. The temperature of the chamber in which the particulate filters would be conditioned and weighed is to be maintained within 295 K ± 3 K (22 °C ± 3 °C) during all filter conditioning and weighing. The humidity shall be maintained to a dew point of 282.5 K ± 3 K (9.5 °C ± 3 °C) and a relative humidity of 45 % ± 8 %. The analytical balance used to determine the weights of all filters is to have a precision (standard deviation) of 20 µg and a resolution of 10 µg (1 digit = 10 µg). For filters less than 70 mm diameter, the precision and resolution shall be 2 µg and 1 µg, respectively.	

26	**Training, Commissioning and Spare Parts** **Pre-acceptance** The particulate measurement system along with CVS would be inspected at the manufacturer's premises before packing. After checking test reports of individual items and physical inspection, acceptance would be given. For this purpose, one scientist of the Indian Institute of Petroleum would be deputed. The charges for this for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, lodging, boarding and daily allowance, etc. **Operation and Maintenance Training** Equipment operation and maintenance training is required for the particulate measurement system along with CVS for one person of Indian Institute of Petroleum at the manufacturer's premises before shipment of the equipment. The charges for this training for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, boarding and daily allowance, etc. **Installation and Commissioning at IIP Dehradun** The installation and commissioning of the equipments at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment. **Spares and Consumable Parts** The spares and consumable parts required for the equipments for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned.	

27	**EMISSION GAS ANALYZER FOR GASOLINE/DIESEL/ALCOHOL/ CNG/LPG ENGINES EQUIPPED WITH EMISSION CONTROLLED DEVICES** Analyzer Type **The Emission Gas Analyzer for Gasoline/Diesel/Alcohol/CNG/LPG Engines Equipped with Emission Controlled Devices shall be capable of measuring EGR Raw Exhaust, Raw Exhaust Pre-Cat, Raw Exhaust Post-Cat and ESC Sampling Line and ETC Raw Line, Diluted Exhaust Measurement, and hot continuous measurement close to dilution tunnel. Calculation of catalytic converter efficiency and particulate trap evaluation shall** **be included. The analyzer lines would be as follows:** **Line 1 : Raw Exhaust Pre and Post Cat including Raw EGR** **This will consist of THC FID & CH4 Cut FID, NOx CLD, CO-high, CO-low NDIR, CO2 NDIR and O2 PMO. The system should be capable of measuring on-line raw exhaust.** **Line 2 : Diluted Exhaust** **This will consist of THC FID & CH4 Cut FID, NOx CLD, CO-high, CO-low NDIR, CO2 NDIR and O2 PMO.** **Line 3 : Hot Continuous Measurement Close to Dilution Tunnel** **This will consist of HTHC FID & CH4 Cut FID, HNOx CLD.** **Emission Gas Analyzer along with the Full-Flow and Partial-Flow Dilution Particulate Measurement System should meet requirements of following test standards:** • **European Directive 2005/78/EC** • **European Directive 2005/55/EC for Euro-III, IV Transient test cycles like European Transient Cycle (ETC) and ESC** • **EPA Cycles like US heavy duty transient cycle (FTP)** • **ISO 16183 using partial-flow tunnel**	

- **US HD 2007**
- **Simulated Vehicle Cycles**
  - **EDC - EUDC**
  - **FTP-75**
- **System shall measure 13-mode diesel emissions and 8-mode diesel emissions from off-road engines**

The system should be able to measure catalytic converter efficiency like D-NOx Catalyst and also efficiency of particulate traps.

28 **Analyzer Ranges**

Component	**CO(L)**
Range	**0-50-5000 ppm**
Repeatability	**<±0.5% FS**
Repeatability	**<±0.5% RS**
Drift (Zero)	**(>100ppm)<±1%FS/24**
Drift(span)	**(>50ppm)**
Noise	**<±1%FS**
Linearity	**<±1%FS or <±2%RS**
T90	**(<100ppm)< 3 sec**
Sample flow rate	**3 l/min**

Component	O_2
Range	O_2 0-1-25%
Repeatability (zero)	<±0.5% FS
Repeatability (span)	<±0.5% RS
Drift (Zero)	<±1%FS/h
Drift(span)	<±1%FS/h
Noise	<±1%FS
Linearity	<±1%FS or <±2%RS
T90	<2 sec
Sample flow rate	0.7 l/min

Component	CH_4 cutter type
Range (DSR)	0-5-50ppm 0-100-250ppm
Repeatability (zero)	<±0.5% FS
Repeatability (span)	<±0.5% RS
Drift (Zero)	<±1%FS/24h
Drift(span)	<±2%FS/24h
Noise	None
Linearity	<±1%FS or <±2%RS
T90	15±1 sec
Sample flow rate	0.5 l/min

Component	NOx
Range (DSR)	0-10-500ppm 0-1000-10000ppm
Repeatability(zero)	<±0.5% FS
Repeatability (span)	<±0.5% RS
Drift (Zero)	<±0.5%FS/24h
Drift(span)	<±0.5%FS/24h
Noise	<±2%FS
Linearity	<±1%FS or <±2%RS
T90	NO: within 1.5 sec NOx: within 2.0 sec
Sample flow rate	0.5 l/min

Component	THC
Range (DSR)	0-10-500ppm 0-1000-50000ppm
Repeatability(zero)	<±0.5% FS
Repeatability (span)	<±0.5% RS
Drift (Zero)	<±1%FS/24h
Drift(span)	<±1%FS/24h
Noise	<±1%FS

	<table><tr><td>**Linearity**</td><td>**<±1%FS or <±2%RS**</td></tr><tr><td>**T90**</td><td>**<1.5sec**</td></tr><tr><td>**Sample flow rate**</td><td>**2.0 l/min**</td></tr></table> **Analyzer Special Functions** **The analyzer shall have following special functions:** • **Automatic calibration** ○ **For direct measurement and for CVS measurement (for Dilute/Bag measurement** • **Touch screen** • **0 to 10 V analog output for all measured channels or digital data recorder** • **External gas divider (critical orifice type for better accuracy), minimum 20 points, accuracy better than 0.5 %.** • **Span Gas Selector for 4 span gases per component (CO2 and O2, 2 span gases)** • **Line leak checker** • **Interference checker for CO_{low} analyzer** • **NOx quenching check** • **Power cable** • **Interconnecting cables & LAN cables.**	
29	*Training, Commissioning and Spare Parts* **Pre-acceptance** The emission gas analyzer system would be inspected at the manufacturer's premises before packing. After checking test reports of individual items and physical inspection, acceptance would be given. For this purpose, one scientist of the Indian Institute of Petroleum would be deputed. The charges for this for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, lodging, boarding and daily allowance, etc. **Operation and Maintenance Training** Equipment operation and maintenance training is required for the emission gas analyzer system for	

	one person of Indian Institute of Petroleum at the manufacturer's premises before shipment of the emission gas analyzer system. The charges for this training for one person for about one week should be included in the offer and quoted separately. This should include travel from Dehradun, India to manufacturer's premises abroad, visa and insurance fee, boarding and daily allowance, etc. **Installation and Commissioning at IIP Dehradun** The installation and commissioning of the equipment at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment. **Spares and Consumable Parts** ***The spares and consumable parts required for the equipments for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts*** ***including unit price should be mentioned.***	
30	**CONDITIONED AIR SUPPLY FOR DIESEL ENGINES** The inlet air given to the engine shall be temperature, pressure and humidity conditioned. The unit shall be suitable for Euro-III and Euro-IV, ESC, ELR, ETC application. System shall be supplied with Hot wire type air flow measuring system. The unit shall be compact and mobile and the specifications are given below: • **Air flow: 60-2400 m ^{3}/h. If the combustion air generator is also used for supply of the CVS dilution air and separate arrangement is not made for**	

	the same, the flow will be 9,600 m ^{3}/h • **Adjustable air temperature: 20-30 deg Celsius** • **Adjustable intake air pressure: Ambient to 100 kPa** • **Adjustable air humidity: 30 –70 % RH** • **Accuracy:** o **Temperature: + 0.5 deg Celsius** o **Pressure : + 1 kPa** Response time: Suitable for transient cycles.	
31	**Spare Parts, Commissioning and Operation Training** **<u>Spares and Consumable Parts</u>** The spares and consumable parts required for the equipment for three years of operation should be included in the offer and quoted separately. The details of all the spares and consumable parts including unit price should be mentioned. **Installation, Commissioning and Operation Training** The installation and commissioning of the equipment at Indian Institute of Petroleum, Dehradun would be the responsibility of the manufacturer. The service engineers of the manufacturer deputed for installation and commissioning would also provide training to IIP personnel at the same time. Manufacturer would inspect the equipment installation site at IIP and would provide the drawings for any civil work, if required and would take the responsibility of supervision for making it ready for the installation of the equipment.	
32	**EXPERIENCE AND AFTER SALES SERVICE** The supplier offering the system should have supplied at least three Heavy-duty Transient Test Beds in India during last 3 years. They should have a service centre in India and trained personnel for after-sales service. The supplier shall also give an	

	undertaking that supply of spare parts for the system would be insured for at least ten years.	
33	**OPTIONAL ITEMS** The supplier is required to quote following additional items separately. **Engine Combustion Analysis System** An engine combustion analysis, high speed data acquisition, system, suitable for the range of engines mentioned in Section 3.1 may be offered as an optional item and quoted separately. **Vehicle Simulation Software** Vehicle simulation software to simulate vehicle cycles like EDC-EUDC, FTP 75, etc. on the transient test bed may be offered as an optional item and quoted separately. The software should be capable to take test data of vehicle and to run on the transient dynamometer for development and optimization work. It should be capable of simulation for as follows; ♦ Vehicle performance testing ♦ Pre-tuning of electronic control units and pre-calibration in engine test cells ♦ Dynamic engine performance with simulation of vehicle and driver ♦ Realistic durability testing that replicated vehicle behavior	

ANNEXURE ‘A’

DETAILED, CONFIGURATION, SPECIFICATION OF THE EQUIPMENT OFFERED.

ANNEXURE 'B'

WARRANTY CERTIFICATE

We Warrant that everything to be supplied by us hereunder shall be brand new, free from all defects and faults in materials, workmanship and manufacture and shall be of the highest grade and quality and consistent with the established and generally accepted standards for material of the type ;ordered shall be in full conformity with the specification, drawing, or samples, and operate properly. We shall be fully responsible for its efficient operation. This Warranty shall survive inspection of any payment or and acceptance of the goods but shall expire after (expect in respect of complaints of which the contractor has been notified prior to such date) 12 months after their successful installation, commissioning and acceptance by the Council/IIP.

The obligations under the Warranty expressed above shall include all costs relating to labor, spares, maintenance (preventive and unscheduled) and transport charges from site to the manufacturers work and back and free repair/adjustment or replacement at site or any parts of the equipment which under normal and proper use and maintenance proves defective in design, material or workmanship or fails to conform to the specifications previously given by the Council/IIP to the contractor.

Signature and Stamp
Of the Tenderer

Date:

Place:

ANNEXURE 'C'

COST AND OTHER DETAILS OF THE SYSTEM OFFERED

		COMPONENT F.E.	COMPONENT RUPEE
1,	Total cost of the System/Equipment		
	(a) FOB Prices (in case of imports)		
	(b) EXW Prices (in case of indigenous Offers)		
2.	Cost of spares, tools and test equipments		
3.	(a) Estimated cost of air freight, insurance, transportation etc. upto N.Delhi Airport.		
	(b) Cost of forwarding, inland Transportation, packing, insurance etc. (in case of indigenous offers)		
4	(a) Training Cost, (in India) if any,		
	(b) Training Cost (in foreign) if any:		
	(*please indicate place, duration and number of persons included)*		
5.	Payment terms:		
6.	Delivery Period :		
7.	Country of origin:		
8.	Port of shipment:		

Signature and Stamp
Of the Tenderer

Place:
Date:

ANNEXURE 'D'

DEVIATION STATEMENT FORM

1) The following are the particulars of deviations from the requirements of the tender documents:

CLAUSE	DEVIATION	REMARKS (INCLUDING JUSTIFICATION)

Place:

Date:

Signature and seal of the Manufacturer/Tenderer

NOTE:

1) Where there is no deviation, the statement should be returned duly signed with an endorsement indicating "No Deviations"

ANNEXURE 'E'

PROFORMA FOR PERFORMANCE STATEMENT
(For a period of last 5 years)

Bid No……..Date of Opening……..…. Time…….Hours……...

Name of the Firm……. Description of item……

Order placed by (full address of purchaser)	Order No. and date	Description and quantity of ordered equipment	Price Charged	Date of completion of delivery As per contract Actual	Remarks indicating reasons for late delivery, if any	Has the equipment been installed satisfactory? (Attach a certificate from the purchaser/ Consignee)	Contact Person alongwith Tel. No., Fax No. & E-Mail address
1	2	3	4	5	6	7	8

ANNEXURE 'F'

SERVICE SUPPORT DETAILS

S.No.	Nature of training imparted	List of similar type equipments serviced in the past 3 years	Local Address, Telephone nos. and Fax Nos. & email address	Value of minimum stock of consumable spares held at all times	Value of AMC after expiry of warranty period for the system offered

ANNEXURE 'G'

BID SECURITY/EARNEST MONEY DEPOSIT FORM

Whereas .....……..1 *(hereinafter called "the Bidder")* has submitted its bid dated ..... *(date of submission of bid)* for the supply of ..... *(name and/or description of the goods)* (hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that WE ..... *(name of bank)* of ..... (name of country), having our registered office at .....……*(address of bank)* (hereinafter called "the Bank"), are bound unto ..... *(name of Purchaser)* (hereinafter called "the Purchaser") in the sum of _____ for which payment well and truly to be made to the said
Purchaser, the Bank binds itself, its successors, and assigns by these presents. Sealed with the Common Seal of the said Bank this ____ day of _____ 20 _____THE CONDITIONS of this obligation are:

1. If the Bidder withdraws its Bid during the period of bid validity specified by the Bidder on the Bid Form; or

2. If the Bidder, having been notified of the acceptance of its bid by the Purchaser during the period of bid validity:

(a) fails or refuses to execute the Contract Form if required; or
(b) fails or refuses to furnish the performance security, in accordance with the Instruction to Bidders.

We undertake to pay the Purchaser up to the above amount upon receipt of its first written demand, without the Purchaser having to substantiate its demand, provided that in its demand the Purchaser will note that the amount claimed by it is due to it, owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.

This guarantee shall remain in force up to and including forty five (45) days after the period of the bid validity, and any demand in respect thereof should reach the Bank not later than the above date.

.....
(Signature of the Bank)

_____

1 *Name of Bidder*

ANNEXURE 'H'

PERFORMANCE SECURITY FORM

To: _____(Name of Purchaser)
WHEREAS ..... (Name of Supplier) hereinafter called "the Supplier" has undertaken , in pursuance of Contract No..……..... dated,..... 20... to supply..... .....(Description of Goods and Services) hereinafter called "the order".

AND WHEREAS it has been stipulated by you in the said order that the Supplier shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with the Supplier's performance obligations in accordance with the order.

AND WHEREAS we have agreed to give the Supplier a Guarantee:
THEREFORE WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Supplier, up to a total of ……..... (Amount of the Guarantee in Words and Figures) and we undertake to pay you, upon your first written demand declaring the Supplier to be in default under the order and without cavil or argument, any sum or sums within the limit of ..... (Amount of Guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the …….....day of…….....20..…….

Signature and Seal of Guarantors
.....
.....
.....
Date.....20....
Address:.....
.....
.....

All correspondence with reference to this guarantee shall be made at the following address:

_____
(Name & address of the lab)

ANNEXURE 'I'

BANK GUARANTEE FORM FOR ADVANCE PAYMENT

To: _____*(name of Purchaser)*
_____ ___*(address of Purchaser)*
_____ _____*(name of Contract)*

Gentlemen:

In accordance with the provisions of the Purchase Order no._____, dated _____, M/s _____, (*name and address of Supplier)* (hereinafter called "the supplier") shall deposit with *(name of Purchaser)* a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of *(amount of guarantee * (in words)*.

We, the _____*(bank or financial institution)*, as instructed by the Supplier, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to *(name of Purchaser)* on his first demand without whatsoever right of objection on our part and without his first claim to the Supplier, in the amount not exceeding _____*(amount of guarantee)** _____*(in words)*.

We further agree that no change or addition to or other modification of the terms of the Contract to be performed there under or of any of the Contract documents which may be made between *(name of Purchaser)* and the Supplier, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment received by the Supplier under the contract until _____.

Yours truly,

Signature and seal :
Name of bank/
financial institution :
Address :
Date :

_____

- An amount is to be inserted by the bank or financial institution representing the amount of the Advance Payment.